

Applying Semi-Automatic Log Normalization to Increase the Reliability of Petrophysical Evaluation and to Maximize the Value of Acquired Data

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Abstract

The reliability of petrophysical interpretation depends on the log data quality, especially in complex environments. In particular, the quality of the Neutron log is crucial for an accurate evaluation of complex carbonates and feldspathic sands. Failing to recognize and address log quality issues might compromise field development decisions. Inconsistent Neutron log corrections were observed in several fields in the North of the Sultanate of Oman, especially in wells drilled with high salinity muds.

Consequences of inconsistent Neutron log corrections are overestimation of porosity and hence hydrocarbon saturation in carbonates. In clastic sections, net to gross identification was compromised. Thus, it is crucial to normalize the log data to have an accurate evaluation which represent the reservoir properties, especially on Exploration stage. A semi-automatic algorithm approach is suggested for neutron log data normalization which is based on logs response in the sections of clean limestones. The assumption is that neutron porosity should be matching with the porosity from density across the clean limestone zones. Later, the approach was further upgraded to use other clean lithologies for the normalization.

The approach utilizes Gamma Ray distribution to identify clean lithologies, photoelectric factor for mineralogy characterization, and a combination of borehole quality indicators. The correction formula can be obtained by correlating the original neutron versus the synthetic Neutron obtained from density-photoelectric factor joint interpretation in the clean zones. The correction is applied on the data only if specific validation criteria met. The Neutron log is affected by many factors, e.g., borehole salinity, mud weight, temperature, standoff corrections, etc. In the saline mud environment, the issues with neutron data could not be fully resolved by applying the traditional environmental corrections. The results of normalization using the new technique show good agreement with the mudlogs and core. The log normalization helped to come up with more realistic estimation of the potential of complex carbonates, optimizing contingency logging on Exploration stage, especially sampling. Besides, good prediction of geomechanical properties from standard Triple combo logs was achieved.

This paper describes the new normalization methodology including quantitative use of Photoelectric log data which is often underutilized. It resulted in a step improvement of the quality of Petrophysical evaluation.